

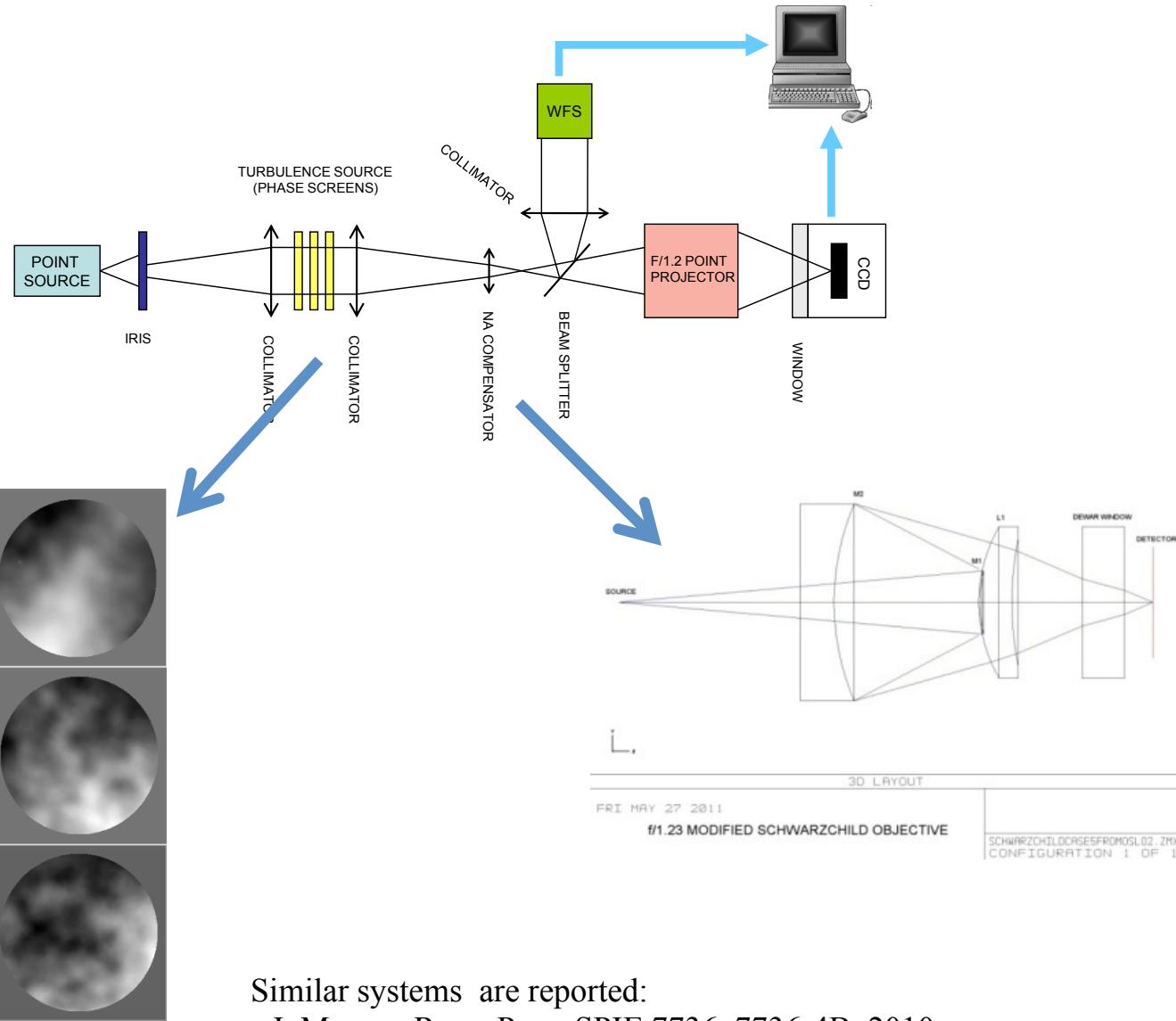
Telescope and atmosphere simulator for sensor studies

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Motivation

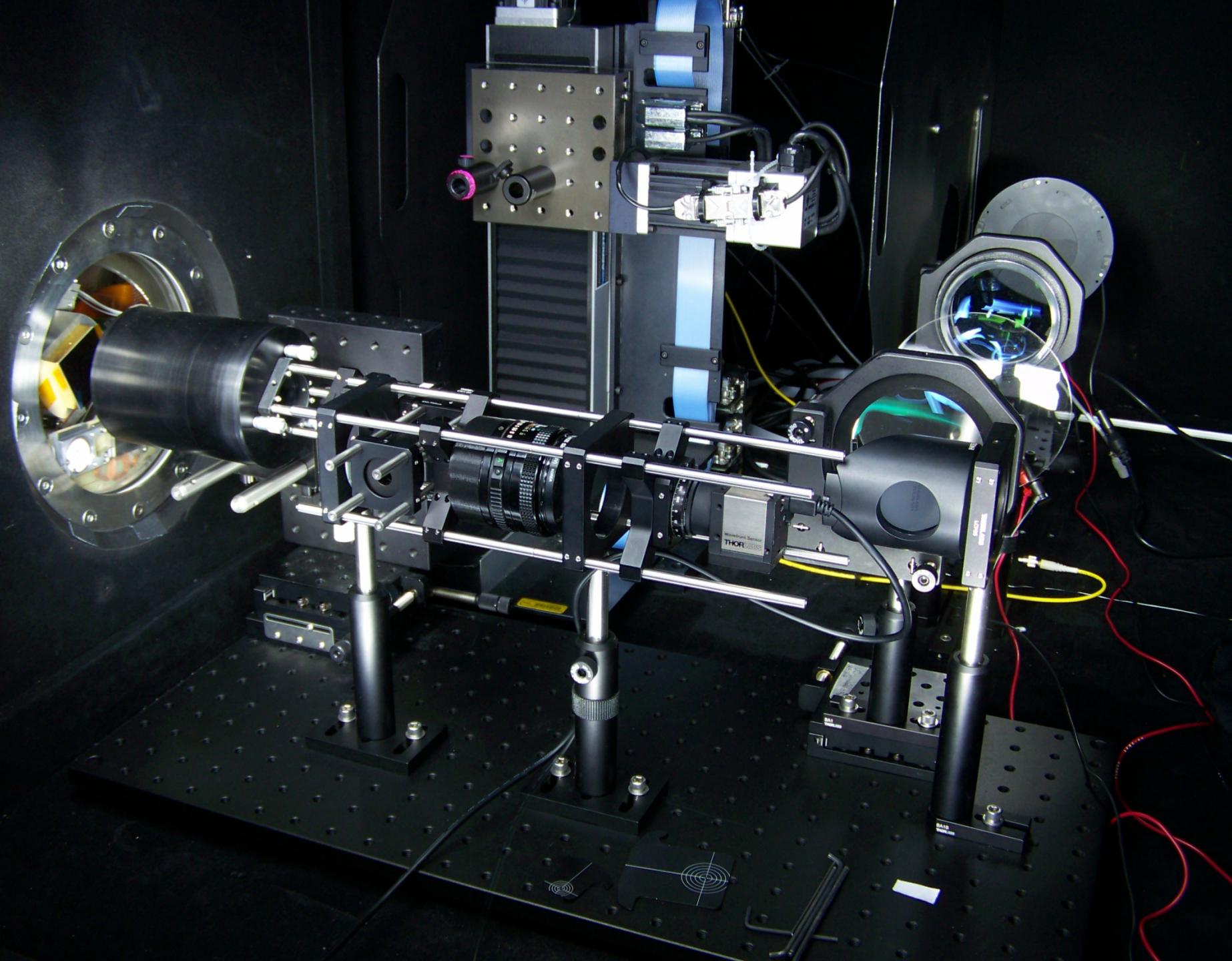
- LSST standard sensor acceptance tests use limited image types (dark, ^{55}Fe xrays, flats).
- UC Davis (Tyson group) has developed an f/1.2 imager for projecting wide-field simulated images on a CCD.
- Neither of these lab setups can easily produce images having representative stellar PSFs.
- We have built a point projector and crude atmosphere simulator for making on-axis images of point sources.
- Our projector uses scaled versions of the LSST optical prescription, the CTIO atmospheric turbulence profile, and wind speed to generate stellar-like PSF on CCD in the lab.

Block diagram

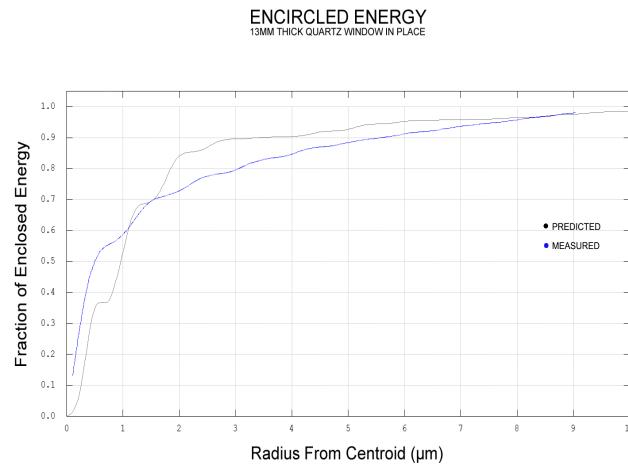
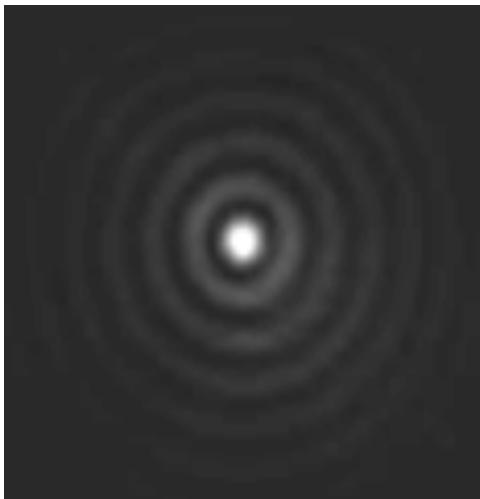


Similar systems are reported:

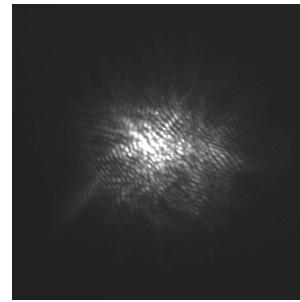
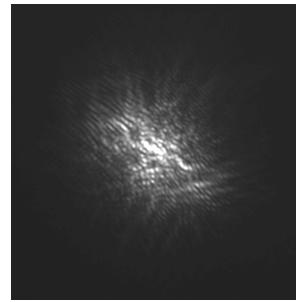
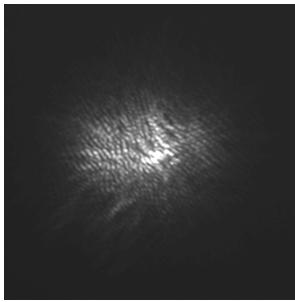
- J. Moreno Raso, Proc. SPIE 7736, 7736-4B, 2010
- LIDAX: http://www.lidax.com/en/?page_id=746



Reimaged/magnified spot images

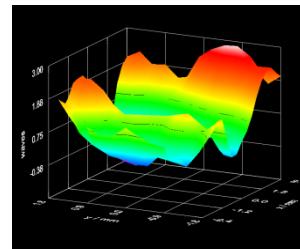
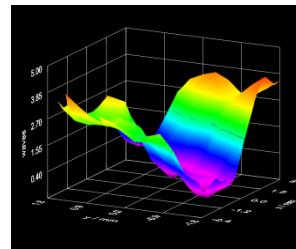
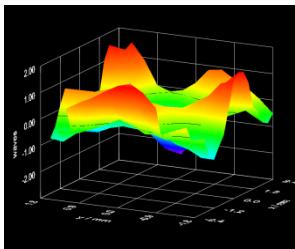


In focus, no phase screen



0.1s exposures with
phase screen:

images



wavefronts

Size and intensity dependence of PSF

- The “brighter-fatter” phenomenon seen in lab and sky data particularly in FDCCDs (p- and n-type).
- Linked to correlations caused by electrostatic deformation of pixel boundaries by collected charge (Astier et al. 2014) , or possibly increased diffusion (Holland et al. 2014).
- Also seen in suppressed variance in flats.
- Is there a dependence on the optical PSF (i.e. seeing disc size) as well as the flux?

First studies with variable-size spots

1. Using point projector in focus with no atmosphere
 - FWHM \sim 1.4 pixels (equiv. 0.27" at LSST plate scale)
 - Change fluence by exposure time
2. Adding atmosphere simulator
 - FWHM \sim 3.9 pixels (0.78")
 - Change fluence by laser intensity, keep exposure time constant

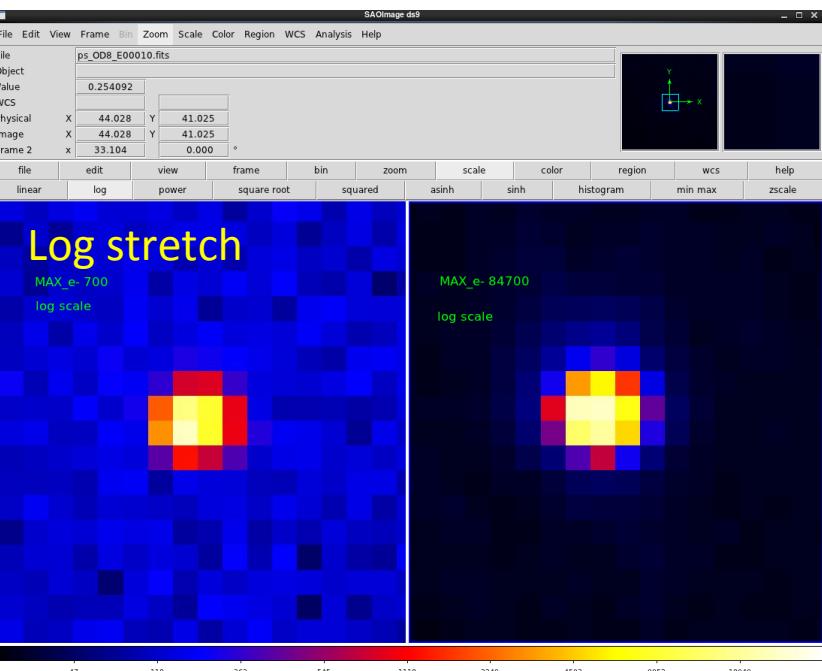
In each case take multiple images at equal fluence.

Preliminary analysis:

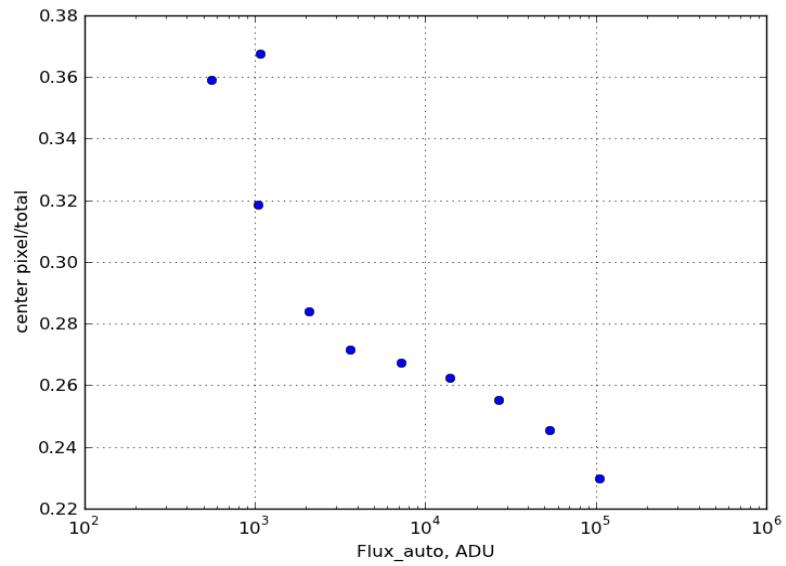
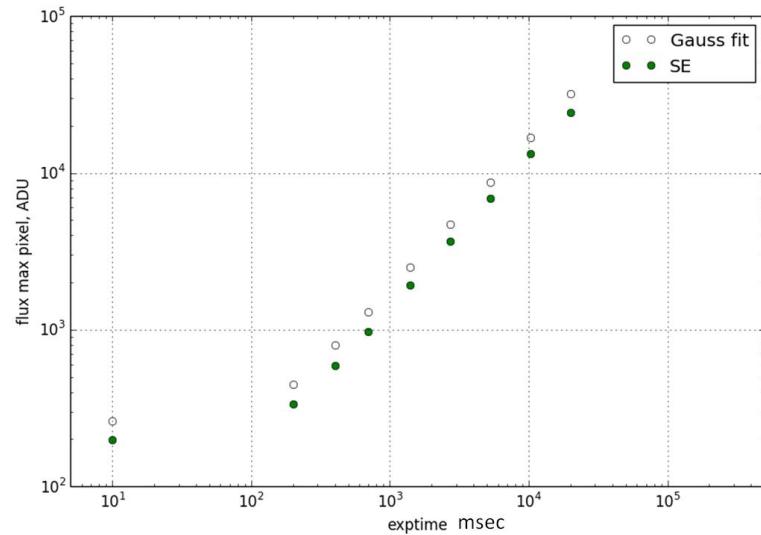
- Debias and coadd images at equal fluence
- Peak flux, centroids, widths by SExtractor and by 2D Gaussian fit
- Radial profile using SE centroids

Concerns:

- Possible drift of spot centroid contaminating coadded image size
- Size measurement S/N bias

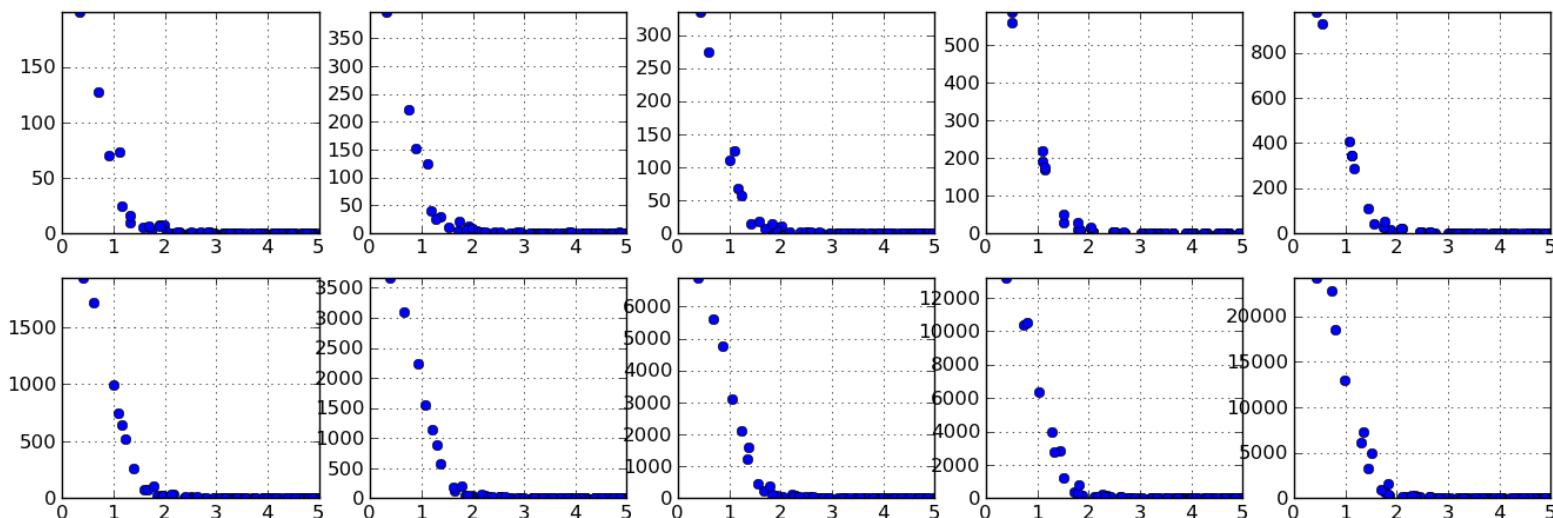
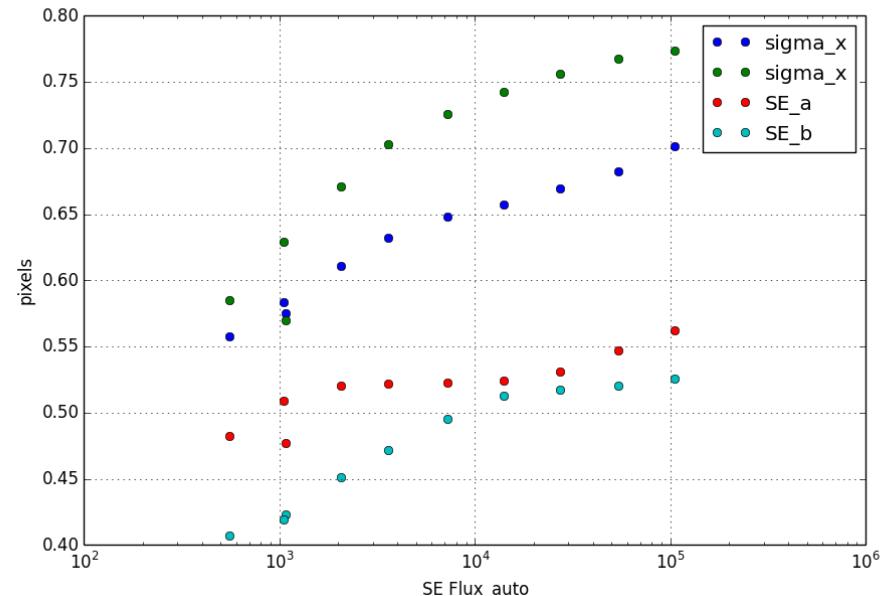


1. Focused spot, no phasescreen



Focused spot, no phasescreen

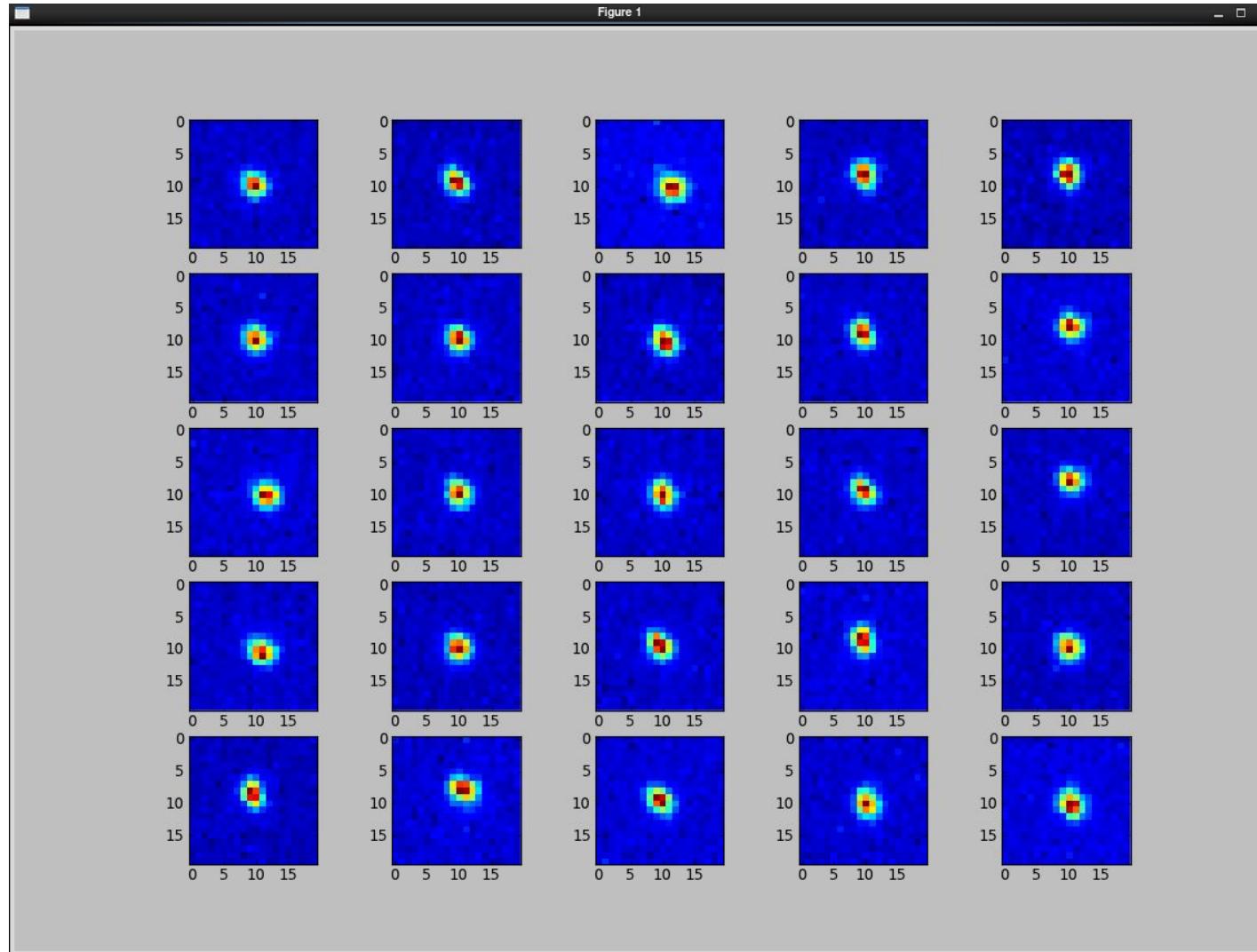
Size measures vs. flux



2. With atmosphere simulation

Phase screen rotation ~ 1cycle/second

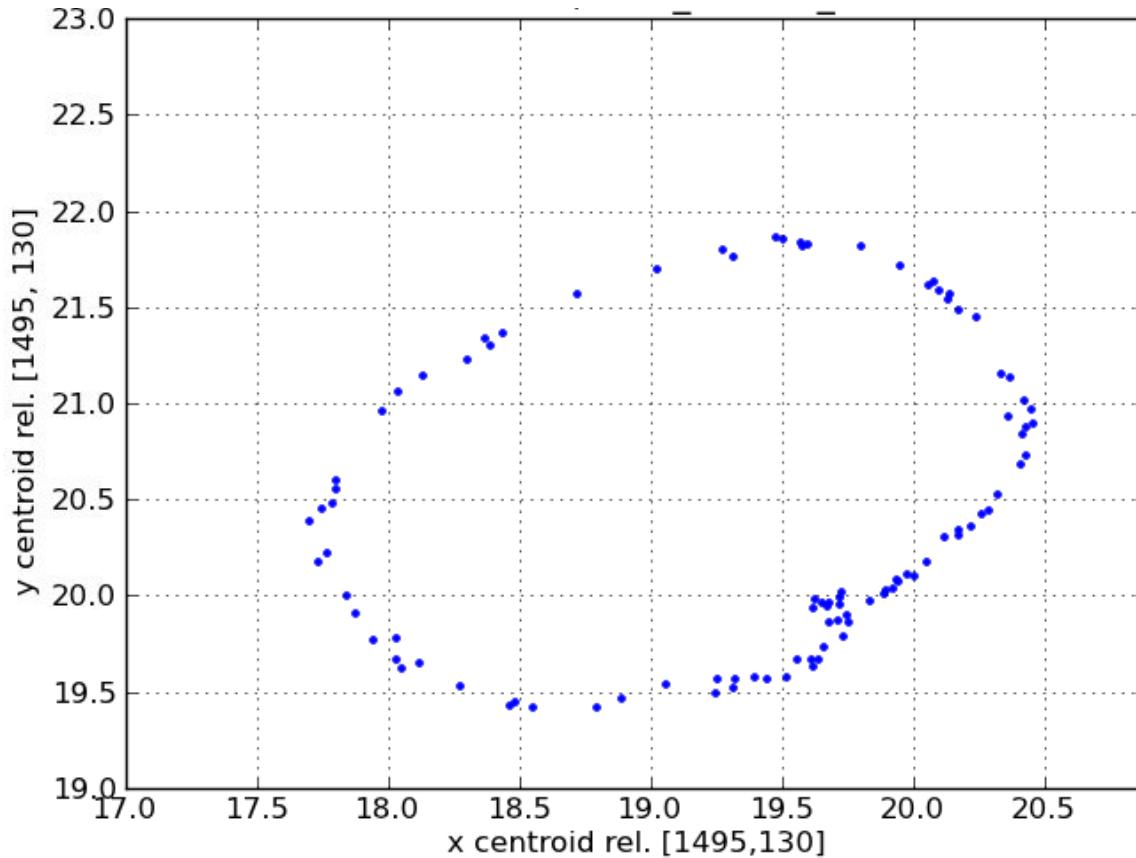
0.05s integration time



2. With atmosphere simulation

Phase screen rotation ~ 1cycle/second

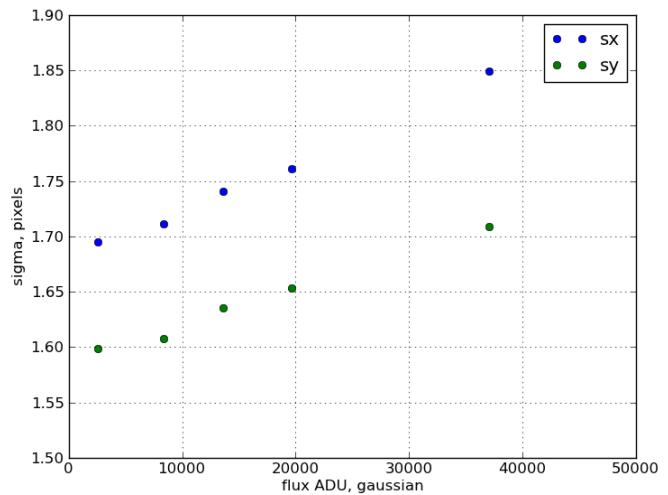
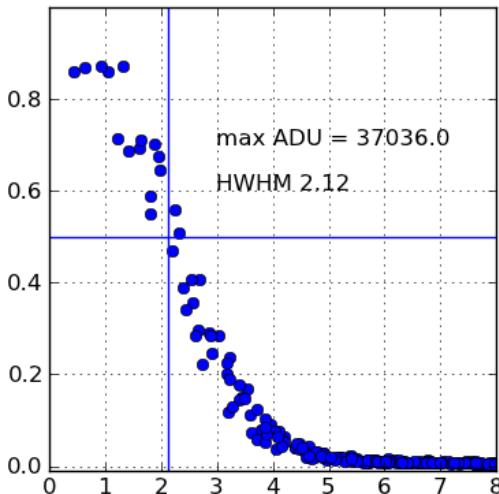
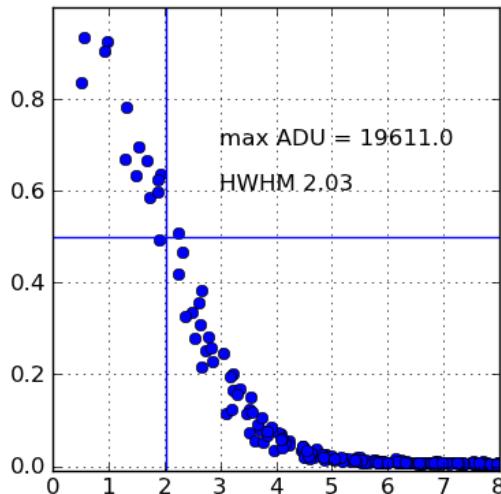
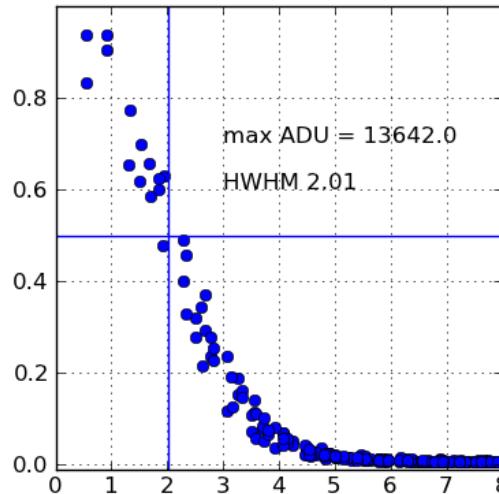
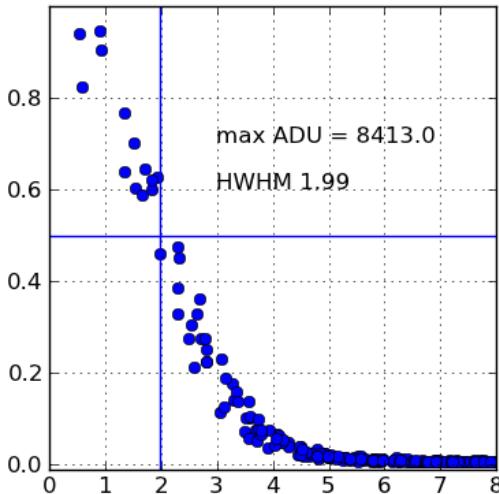
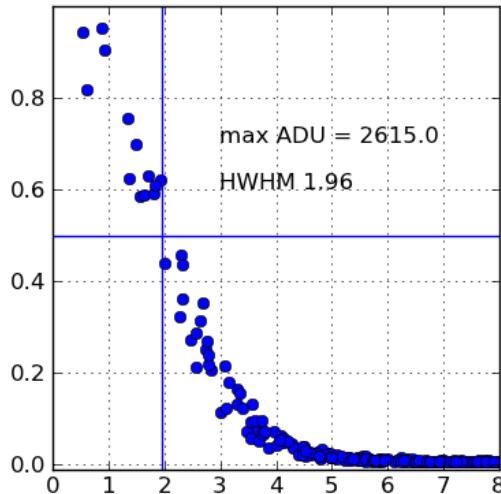
0.05s integration time



2. With atmosphere simulation

Phase screen rotation ~ 1 cycle/second

15s integration time



MORE TO COME...